FIBREGLASS COMPOSITE RECYCLING

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Report prepared for:
Program Development Branch
Ontario Ministry of Environment and Energy

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EXECUTIVE SUMMARY

Phoenix Fibreglass Inc., located in Oakville, Ontario, has developed the first practical and economically-viable process to recycle fibreglass composites.

Fibreglass composite, because of its relatively low cost and high strength-to-weight ratio, has become a favoured material in the manufacture of automobile and electrical components, construction products, and for many other uses. Until now, it has had one major disadvantage: in a world that has become increasingly environmentally-conscious, it has not been recyclable. This is of particular concern to the automobile companies who are insisting that the components they use must be recyclable.

The Phoenix process, for which patents have been granted in the U.S. and are pending in Canada and in many other countries, is the first to separate the constituent reinforcing fibres from the resin and fillers. and has the advantage of being a "closed loop" process, as the resulting recycled fibres are being used in composite manufacture, while the powdered resin and fillers are being used as filler replacements.

Following initial research conducted at ORTECH International, (formally the Ontario Research Council) in 1991, a pilot plant was constructed to resolve a number of equipment issues and to demonstrate the products to the composite industry. At the same time, Phoenix organized a successful promotional campaign which resulted in widespread publicity for its achievements, bringing enquiries from around the world. A full-scale plant is now nearing completion at Oakville and commissioning is anticipated to be complete by the second quarter of 1994. This plant is expected to reach a capacity of 6,000 tons/year on two shifts in late 1995. Fibreglass waste material is currently being disposed of at a significant cost to the manufacturers and can be diverted to Phoenix instead at no charge. Once systems for the collection and sorting of post-consumer waste composites (such as parts from scrapped automobiles, as opposed to post-industrial waste, which is from the manufacturing process) have been put in place, Phoenix will also use this source as raw material.

Phoenix is concentrating on selling its products to manufacturers of automobile parts, makers of home building products such as lighting fixture housings and shower stalls, and to the construction industry. A number of supply contracts have already been signed and numerous others are pending.

Once the Oakville plant reaches profitability and the technology is proven, it is anticipated that licensing or joint venture agreements will rapidly follow, and additional recycling facilities will be constructed. A number of enquiries regarding technology transfer have already been received.

The company has been financed to date by a group of private individuals who have invested $3,710,000, a small business development loan of $250,000, and govemment grants totalling approximately $1,000,000. Of the $1 million in grants, $406,795 was received from the Ontario Govemment's Waste Diversion Fund. Phoenix projects an additional $1,000,000 will be required to fund plant commissioning and operating costs until positive cash flow is established the second quarter of 1995. Negotiations in securing these funds are well advanced.

PHOENIX FIBREGLASS INC.

1. BACKGROUND

Fibreglass composite material, or plastic reinforced with glass fibre, has a number of significant advantages over other construction materials. These advantages are primarily related to fibreglass' exceptionally high strength-to-weight ratio and its relatively low cost. Fibreglass is used extensively in the construction industry for components such as shower stalls, sinks, decorative panels and corrosion resistant tanks; in boat building; for receptacle boxes and panels in the electrical industry; and in the transportation industry where the combination of fibreglass' light weight and high strength have been particularly attractive to automobile manufacturers.

The automobile industry's search for lighter weight vehicles which meet increasingly stringent fuel consumption regulations, as well as the pursuit of more design flexibility, has led to its increased use of fibreglass. This increase in the use of fibreglass has however, also resulted in an increase in waste, both during manufacture, and at the end of the useful life of the automobile. This is because, until now, fibreglass composites have had one serious disadvantage. Despite the efforts of a number of large raw material and composite manufacturers, fibreglass has been impossible to economically recycle.

The move towards increased conservation and re-use of non-renewable resources appears to be irreversible. This is currently most evident in Germany where recyclability is mandated for manufacturers, especially the auto industry. In response to strong public demand, governments throughout the world are discouraging landfill and incineration of "waste" materials, and encouraging reuse and recycling. As a result of efforts over the past decade, Ontario is at the forefront of waste management and recycling in North America. The government's aggressive policies have created an ideal environment in which to develop new recycling technologies, for both domestic use and as an exportable technology, such as Phoenix's.

In 1990, Bryan Sims, a yacht architect from Oakville, Ontario, who used fibreglass extensively in boat construction, started looking for a technically and economically viable process to recycle fibreglass.

In June, 1991, following a year of promising research carried out under contract by ORTECH International of Mississauga, Ontario (formerly the Ontario Research Foundation), Phoenix Fibreglass Inc. was incorporated. Phoenix Fibreglass Inc. is a private company registered in Ontario, Canada and is financed by 38 private investors, of which 30% are U.S.-domiciled, and grants from the Ontario and Federal governments.

Phoenix's first step was to design and construct a pilot plant to perfect, in a semi-production environment, the components which had been selected during the research phase. The pilot plant, rated at 750 lbs/hour, was completed in the fall of 1992.

Test runs on a wide variety of scrap materials were carried out over the course of a year, and the process was considered proven on a pilot scale. With the process proven, a full scale plant with a throughput of 1.5 tons/hour, was designed and constructed at Phoenix's Oakville, Ontario facility. Approximately 500,000 lbs. of scrap material have been successfully processed to date, separating the glass fibre from the resin and fillers, in such a way that all can be reused.

The plant is located in a leased, 23,000 square foot facility, and is immediately adjacent to major highway and rail networks. It is anticipated that the plant will be fully operational by April of 1994.

2. THE RECYCLING PROCESS

2.1 Raw Materials - Input

Currently, Phoenix uses only waste generated during the manufacture of parts made from a type of fibreglass composite known as sheet molded composite, or SMC, as feedstock. The waste is received in the form of substandard parts or edge trim, for example. Phoenix's process can separate the glass fibres from a variety of fibreglass waste streams, but only SMC is being processed at this time for several reasons; the material is very consistent in its composition regardless of the waste supplier, it has a relatively high glass content, and the auto industry, which is experiencing the greatest political pressure to recycle, generates this type of waste. Other fibreglass waste streams generated in Ontario will also be processed in the future.

Phoenix is currently processing only post-industrial waste, which is scrap produced during the manufacturing process, as opposed to post-consumer waste, because it is the only material currently recoverable. However, the eventual objective is to also recycle post-consumer material because of the quantities that will be available. "Post-consumer" waste refers to material that has reached the end of its useful life, such as an old car, or a shower stall from a house being demolished. The North American auto industry has forecasted that within five years, the post-consumer SMC waste stream from scrap automobiles will be in the order of 200 million pounds annually.

On urgent request by the North American automobile industry, Phoenix has already begun to examine what would be required to source post-consumer fibreglass car parts. Phoenix is arranging a pilot project with the Automotive Recyclers of America (A.R.A), in which the A.R.A. will collect post-consumer fibreglass car parts for Phoenix. The project with the A.R.A. is intended to identify the infrastructure which would be required to recover, collect and deliver this material to Phoenix. Phoenix is also contacting Ontario car dealerships and body shops in an effort to begin diverting limited amounts of post consumer scrap.

2.2 Output

Fibreglass generally consists of glass fibre, polyester resin, and a filler which is usually calcium carbonate. Phoenix's process separates waste SMC essentially into its component parts. The process produces four product streams with an average expected composition as follows:

Chopped Strand (CSX)	30%
Milled Fibre (MFX)	10%
Coarse Filler (PHX-750)	35%
Fine Filler (PHX-100)	25%

The CSX, or chopped strand glass fibres, are approximately three-quarters of an inch in length, with reinforcing capability similar to virgin glass chopped strand.

The MFX, or milled glass fibres, are single fibres of short length which may be used in the production a variety of reinforced plastics.

PHX-750 is a coarse filler containing glass fibre which provides significant reinforcement value

PHX-100 is a fine filler similar to calcium carbonate filler, but with the added advantage of having a significantly lower specific gravity.

The chopped strand (CSX) and milled fibre (MFX) can both be used as a partial replacement for new glass fibre, while the ground mixtures of resin and filler (PHX-750 and PHX-100) can replace virgin filler. The overall strategy is to maximize the output of the high value fibres, while minimizing the output of filler.

The plant is set up to operate with two eight-hour shifts, five days per week. The operating crew will consist of four employees per shift and a two person maintenance crew. With one shift in operation, the plant is expected to have an annual capacity of 3,000 tons, and 6,000 tons with two shifts. If necessary, the plant could operate around the clock on a three-shift basis.

2.3 Process Description

Waste fibreglass is currently delivered to the plant in bulk via tractor-trailer. The incoming material is shredded and any ferrous or non-ferrous metal contaminants are separated using a magnet and a detector. The material is then fed to a device which strips the fibre away from the resin and filler. The resulting mixture is then directed through a series of separation stages which first recover three-quarter inch chopped strand fibres (CSX), and then smaller milled fibres (MFX).

The remaining resin and filler mixture (which contains a small amount of glass fibre) is conveyed to a high speed pulverizer. The resultant milled powder is classified as either coarse filler (PHX-750), containing some glass fibres, or fine filler (PHX-100), which is similar in physical properties to the filler currently used in the manufacture of composites. Both these fillers are significantly lighter than calcium carbonate, which is currently the standard auto industry material. This advantage over calcium carbonate offers the auto companies the means to further reduce vehicle weight, and thereby improve fuel consumption.

As of February 1, 1994, the full-scale plant is approximately 90% complete. By the beginning of the second quarter of 1994, the plant commissioning and optimization will be complete. Patents for the process were applied for in September, 1991. The U.S. Patent was issued November, 1993, and patents are pending for all other major industrialized countries.

3. M.O.E.E. CONTRIBUTION

On April 16 1992, the Ministry of The Environment and Energy's Industrial Waste Diversion Program awarded Phoenix Fibreglass Inc. a grant of $406,795. These funds were to be applied against the purchase of specific pieces of equipment at the rate of 21 per cent of the cost of each piece of equipment. The overall plant construction budget was originally estimated at $2.5 million, however due to Phoenix's aggressive bidding process, it was actually constructed for $2.0 million. Consequently, purchases eligible under the M.O.E.E. grant totalled $357,236.

4. MARKETS

Use of composites in vehicle manufacturing has grown steadily over the last several years, and is expected to continue to increase. In 1992, SMC use in the auto industry totalled 160 million pounds per year. By 1995, its use is forecast to be 200 million pounds annually.

While the automobile companies prefer composite materials for their high strength-to-weight ratio and their relatively low cost, significant concern has been raised regarding their recyclability. Having seen governments legislate recycling in Europe, the auto companies would prefer to lead the way themselves in North America, before the government forces legislation upon them. Thus, the Ford Motor Company has already included within its design standards for 1997, the requirement that all their car components be recyclable and also contain at least 20 percent recycled content. It is anticipated that the other automotive companies will adopt similar policies.

To satisfy the demand by the auto industry for recycling, the composite industry has been searching for a practical and economic means of recycling fibreglass composite for several years. A number of systems have been suggested including pyrolysis, grinding, and separation of the fibre from the filler (ie. the Phoenix process). At this time, the Phoenix process is widely accepted by the North American fibreglass composite industry as the best technical and economical method for the recycling of cured fibreglass composite scrap.

Phoenix has undertaken a major marketing program and orders have been received for Phoenix's material from auto parts manufacturers. Three major composite molders are now supplying limited production vehicle components containing Phoenix's recycled fillers. General Motors' Corvette is the first vehicle to be produced in North America using composite parts manufactured with recycled material. However, material approved for regular use by the auto manufacturers must first undergo rigorous testing and scrutiny before being viewed as reliable and its producer is designated as an approved supplier. Phoenix is currently in the process of demonstrating its capability and reliability of its material to the auto industry. The Ford Motor Company has offered to provide technical assistance in the implementation of auto industry quality control standards, at no cost to Phoenix.

In agreeing to the concept of recycling composites, the automotive industry has made it clear that the recycled products must be of acceptable and consistent quality, and that they must be economically priced. Phoenix believes that it can meet these criteria with its products, while at the same time provide a much needed alternative to disposing of both industry and consumer waste.

4.1 North American Market

The North American market for fibreglass-reinforced composites of all kinds in 1992 was reported to be approximately 1.35 million tons, of which the majority, approximately 1.3 million tons, was in the U.S.

To date, contracts have been signed for the use of Phoenix's material in the Chevrolet Corvette's hood, rear window support, and inner door panels; the interior trim of the Chrysler Ram Van; and for the engine cover on the Ford Econoline van.

A number of other parts scheduled to use Phoenix's glass are in the development process. These include grill opening panels, grill opening reinforcements and valve covers in automobile applications; and light housings, fibreglass trays and various electrical components in non-automobile applications. Trials are also taking place using Phoenix's material in reinforced polymer concrete.

In North America, there are no other companies recycling fibreglass composites on a production scale. Phoenix, with its demonstration facility nearing completion is far ahead of any potential competition.

5. MARKETING PROGRAM

5.1 Marketing Strategy

The overall marketing strategy is that, to the greatest degree possible, Phoenix will supply the North American market with recycled material, either directly or with a joint venture partner. Initially, Phoenix will operate from the Oakville facility, but as the market for its recycled products expands and new sources of waste materials are recovered, it will locate new facilities close to end-user markets.

With respect to offshore markets, the strategy is to license Phoenix's technology. Patent applications have been filed in all major European countries, the Russian Federation, Australia, Mexico, Taiwan, China, and others. Once the new plant in Oakville is successfully operating, a program to license the technology offshore will begin.

During 1991-1992, Phoenix launched a media relations campaign aimed at the fibreglass composite industry, to publicize the new technology and determine North American and off-shore interest. This successful campaign generated coverage in a variety of newspapers, including The Chicago Tribune and The Toronto Star, as well as in major industry trade magazines. It created a great deal of interest among fibreglass companies, resin manufacturers, composite makers, and end-users of these products such as automobile companies, both in North America and elsewhere as enquiries were received from across the U.S., Mexico, Europe, Japan and Taiwan.

While Phoenix's feedstock is SMC, the first target market for the recycled fibre is the bulk molded compound (BMC) manufacturing industry. This is because the materials Phoenix currently produces are most suited to BMC production. BMC molders already use chopped fibreglass strands, whereas SMC molders require fibreglass mat. There is however, a strong desire by the auto sector to use Phoenix's fibre in SMC production. Phoenix has therefore developed a prototype product in the form of a recycled fibreglass mat which could be used in SMC production with only minor changes to Phoenix's process. This material is now undergoing trials with a select group of molders and has so far been performing well.

5.2 Customer Strategy

Until recently, the marketing emphasis has been on the automotive sector. It is apparent that an equal emphasis must be placed on the non-automotive sector, because it possesses many fibre and filler applications that can be brought to market more rapidly than automotive applications.

In the automotive sector, the strategy involves working closely with the original equipment manufacturers (OEMs), composite manufacturers, and the industry association, the Sheet Molded Composite Auto Alliance (SMCAA), of which Phoenix is a member. Phoenix actively participates on the SMCAA's Technical Committee, which has a high priority on recycling, and is looking at means by which the recycled fibres, in addition to the fillers, may be used in SMC, i.e. fibreglass mat.

Close contacts with the automobile manufacturers are critical in order for Phoenix to clearly understand their objectives, operating methods and standards. A good relationship has already been established with the Ford Motor Company, and contacts are now being established with General Motors and Chrysler. Ford has offered to assist Phoenix in setting up a quality control program, acceptable to Ford and meeting general automobile industry standards.

Phoenix is developing individual strategies to work closely with each of the major auto parts composite manufacturers. It is concentrating particularly on the "early adopters", those companies which, in any industry, are always at the forefront of technical innovation and the adoption of new technologies and techniques. It is with these firms that Phoenix will cooperate in joint technical programs, to minimize any problems that may arise with the introduction of the recycled products. By working closely with these companies and with the OEM's to successfully introduce recycled products to the marketplace, it is anticipated that the other companies will follow.

Although the users of fibreglass composite in the non-automotive sector are much more diverse, Phoenix's customer strategy is nevertheless similar to its approach to the automotive industry. Phoenix is targeting the large companies who are willing to try new products and realize the long-term advantages of recycling. It is anticipated that once the larger companies will set the trend within the industry by successfully demonstrating the advantages of using Phoenix's recycled material.

6 SUMMARY

The timing of the Ontario Ministry of the Environment and Energy's commitment was important as it gave Phoenix Fibreglass Inc.'s credibility a boost, thereby enabling the company to secure significant private financial backing. In summation, the support of the Ministry of the Environment and Energy was instrumental in moving Phoenix Fibreglass Inc.'s technology from, first, laboratory to pilot scale, then pilot scale to commercial scale operations.

Stretch your glass fiber dollars

Phoenix's hybrid glass fibers can now replace a portion of costly virgin glass fibers.

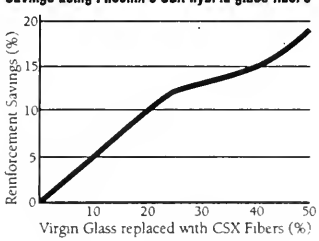
With the price of virgin glass reinforcements rising, it makes sense to look at alternative reinforcements to reduce the cost of your compounds.

Phoenix Fibreglass' new recycled CSX hybrid glass fibers, through a unique sizing system, can now work in conjunction with virgin glass in bulk molded compound applications. Our CSX fibers supplement virgin glass while maintaining product specifications.

Depending on the BMC application, up to 50% of the virgin glass can now be replaced with our hybrid glass strand. The specific gravity of these fibers is approximately 25% less than virgin glass, extending your reinforcements even further.

This all adds up to significant cost savings. The following is a typical example of the savings you can expect.

Savings using Phoenix's CSX hybrid glass fibers



Phoenix also offers a comprehensive technical service program to its customers. Its aim is to support the formulating, compounding and molding of BMC by giving you access to our fully equipped composite laboratory and specialists.

Phoenix Fibreglass, a tier two supplier to the auto industry, has been at the forefront of the SMC Auto Alliance's efforts to prove the recyclability of their product. In fact, the unique patented process that Phoenix has developed has resulted in the most advanced composite recycling facility in the world.

So if you're looking for more information on how to extend your fibers, not to mention your dollars, give us a call at (905) 844-7678.

PHOENIX FIBREGLASS INC

Taking fiberglass technology full-circle

Phoenix Fibreglass Incorporated 364 Davis Road, Oakville, Ontario L6J 2X1 CANADA Telephone (905) 844-7678 Fax: (905) 845-0778

APPENDIX 1

- U.S. Patent

US005251827A

United States Patent [19]

Sims et al.

[11] Patent Number: 5,251,827

[45] Date of Patent: Oct. 12, 1993

[54] PROCESS FOR SEPARATING FIBRES FROM COMPOSITE MATERIALS

[75] Inventors: Bryan Sims, Oakville; Craig A. Booth, Acton; V. I. Lakshmanan, Mississauga, all of Canada

[73] Assignee: Phoenix Fibreglass Inc., Oakville, Canada

[21] Appl. No.: 947,351

[22] Filed: Sep. 18, 1992

[30] Foreign Application Priority Data

Sep. 18, 1991 [GB] United Kingdom 9119944
Jun 18, 1992 [GB] United Kingdom 9212920

[51] Int. Cl.[5] B29B 17/00; B29B 17/02; B03B 9/06

[52] U.S. Cl. 241/24; 241/DIG. 38

[58] Field of Search ..... 241/24, DIG. 38, 68, 241/78, 80

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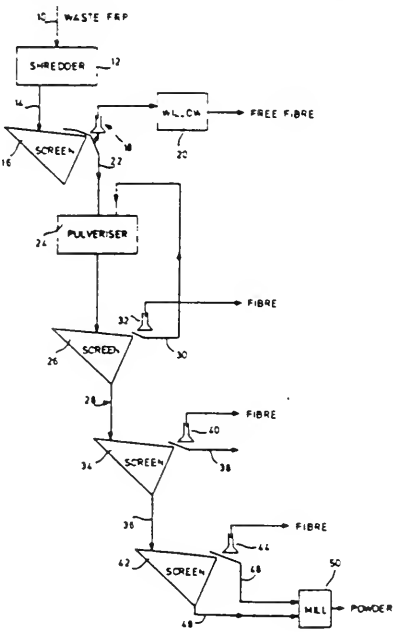
Primary Examiner—Douglas D. Watts
Attorney, Agent, or Firm—Ladas & Parry

[57] ABSTRACT

A resin reinforced fibre product such as glass fibre impregnated with a thermosetting resin is treated to recover fibre by initially shredding the waste, pulverizing the shredded waste and sieving the pulverized waste to separate the free fibres. The remaining waste is milled to produce a fine powder suitable as a filler. The pulverizing is completed without classification and a portion of the pulverized product above a nominal cut size recampaigned. Free fibres are separated by an airlift during the sieving process.

18 Claims, 6 Drawing Sheets



APPENDIX 2

- Phoenix Product Description

Technical Service Program

Phoenix's technical service program is aimed at supporting its customers with the formulating, compounding, and molding of BMC, using Phoenix's unique hybrid glass fibers (CSX). This ongoing program focuses on the customer's mechanical, physical, and aesthetic requirements, while recognizing the need for practical, cost-effective solutions.

To meet customer needs and objectives, Phoenix has outfitted its laboratory with state-of-the-art equipment and has retained the services of U.S. based industry specialists with over 50 years of combined experience in composites. Both the lab equipment and the "in-house" knowledge enable Phoenix to work with a customer to identify, research, and solve problems in either the formulating, compounding, or molding stages of production.

Lab Capabilities and Services

Phoenix's lab is outfitted with a BMC mixer, a 100 ton press, various ASTM specimen preparation equipment, and ASTM mechanical testing equipment. Phoenix also has access to production presses, production size BMC mixing equipment, and SMC machinery. This allows Phoenix to offer the following services to its customers:

- BMC and SMC formulation development.
- Compounding and molding trials.
- Mechanical and physical property testing.
- Small production trials.
- Phoenix material "free of charge" for all stages of formulation development.
- Access to our industry specialists.

Technical Consultants

Phoenix has retained the services of industry specialists who have many years of experience with Owens-Corning and other leading companies, both in thermoplastics and thermoset plastics. Together, they bring many years of detailed experience over a broad range of product lines and are the "hub" of our technical service program.

January, 1994

PHOENIX FIBREGLASS INC

TAKING FIBREGLASS TECHNOLOGY FULL CIRCLE.

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Guidelines for Use of Phoenix's Hybrid Glass Fibers (CSX)

Phoenix's technical support program documents the effectiveness of its hybrid glass fibers (CSX) when used in conjunction with virgin glass in bulk molded compounds (BMC). Phoenix has guildelines for the most effective use of this fiber. We are now able to meet, at a significant cost savings, the mechanical and physical specifications required of a number of applications when varying amounts of the virgin glass fibers are replaced with Phoenix's CSX fibers. As a result of this work, we have reached a number of conclusions:

1. CSX fibers are most effective when replacing 50% or less of the virgin glass fiber used in a formulation.

2. When using CSX fibers, Phoenix recommends that you replace the virgin fiber as follows, in order to obtain similar properties:

   To replace 50% of the virgin glass fiber, use approximately 62.5% of our CSX . (ie. a 1 : 1.25 replacement ratio)

   To replace 25% of the virgin glass fiber, use approximately 27.5% of our CSX. (ie. a 1 : 1.1 replacement ratio)

   For the replacement of virgin glass between 25% and 50%, the replacement ratio should be pro-rated between 1.1 and 1.25.

3. The specific gravity of Phoenix's CSX fiber is approximately 25% less than virgin glass fibers. This advantage allows more parts to be produced for the same weight of material. The difference in specific gravity may need to be taken into account when planning production trials.

4. For formulations requiring low profile and low shrink additives, we recommend the use of certain products. Please consult Phoenix for our recommendations.

5. It is recommended that Phoenix's CSX fibers be added first to the paste in the BMC mixer, followed by the virgin fiber.

January , 1994

PHOENIX FIBREGLASS INC

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January 1994

Phoenix's New Fiber Reinforcement

CSX Hybrid Glass Fibers

KEY FEATURES

- **Cost-Effective Reinforcement**
- **Virgin Glass Extender**
- **Light Weight**

DESCRIPTION

CSX is a 1/2 inch fiber reinforcement suitable for bulk molded compounds and other composites. CSX, a hybrid glass fiber with a unique sizing system, is used in conjunction with virgin chopped strands and/or milled fibers to provide mechanical strength and light weight, while decreasing cost. Depending on the application, up to 50% of the virgin glass can be replaced with CSX, resulting in a significant overall compound savings while still meeting the mechanical and physical specifications of the part.

TECHNICAL SPECIFICATIONS
(Typical)

Specific Gravity, avg	1.9
Polyester resin, %w, avg	27
Calcium carbonate, %w, avg	27
Glass, %w, avg	45
Bauer McNett, % retained on 8 mesh screen	90

PACKAGING DATA

50 lb. pressure packed poly bags
20 bags per skid.

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January 1994

PHX-100

KEY FEATURES

- **Low Specific Gravity**
- **100% Recycled Material**
- **No Requirement for Specialized Processing Equipment**

DESCRIPTION

PHX-100 is a unique, light weight filler product. PHX-100 is a free flowing, grey in colour, filler. PHX-100's specific gravity is approximately 25% less than calcium carbonate.

TECHNICAL SPECIFICATIONS
(Typical)

Specific Gravity, avg.	1.83
Average Particle Size, microns	7
Moisture, %w, max.	0.8
Polyester Resin, %w, avg.	34
Calcium Carbonate, %w, avg.	52
Glass, %w, avg.	13

PACKAGING DATA

50 lb. poly lined bags.
40 bags per skid.

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January 1994

PHX-750

KEY FEATURES

- **Functional Reinforcing Filler**
- **Light Weight**
- **100% Recycled**

DESCRIPTION

PHX-750 is a semi-free flowing powder. With its 25% milled glass fiber content, PHX-750 provides additional reinforcing strength to composites already using virgin chopped strands and/or milled fibers.

TECHNICAL SPECIFICATIONS
(Typical)

Specific Gravity, avg.	1.9
Average Particle Size, microns	40
Polyester Resin, %w, avg.	28
Calcium Carbonate, %w, avg.	47
Milled Fiber, %w, avg.	25

PACKAGING DATA

50 lb. poly lined bags.
40 bags per skid.

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BMC Data

Low Profile BMC Compound

Low profile systems are most commonly used in automotive and electrical applications where dimensional properties are critical. Warpage, dimensional tolerances, and a Class A surface are the important features of this compound. The material shrinkage is approximately 0.0 in/in, and in some cases there may even be a slight growth. Phoenix's CSX hybrid glass fibers have been found effective in low profile systems.

Typical BMC Formulation

Raw Material	pph	%
Ashland 6585	60	11.76
Ashland 2030	40	7.84
TBPB Catalyst	1.5	0.29
Byk 995	1.5	0.29
Aristech Mod ME	1.0	0.20
Zinc Stearate	4.0	0.78
Camel Wite	300	58.84
OCF 405 1/4" Glass Phoenix's CSX Fibers		20.0
	408 pph	100 %

Physical Properties

	Notched Izod (ft-lbs/in)	Tensile Str. (ksi)	Flexural Str. (psi)
Control	5.13 ± 16.2%	5.2 ± 22.1%	13713 ± 17.87%
Replacing 25% using a 1 : 1.1 ratio	4.50 ± 15.7%	4.5 ± 14.3%	10693.5 ± 22.2%
Replacing 40% using a 1 : 1.25 ratio	3.97 ± 15.6%	4.4 ± 18.7%	12198.8 ± 20.4%
Replacing 50% using a 1 : 1.25 ratio	3.73 ± 9.1%	4.4 ± 9.34%	11051.6 ± 14.3%

(Replacing virgin glass with Phoenix's silane sized, CSX hybrid glass fibers)

PHOENIX FIBREGLASS INC

TAKING FIBREGLASS TECHNOLOGY FULL CIRCLE.

364 Davis Road, Oakville, Ontario, CANADA L6J 2X1 Phone (416) 844-7678 Fax (416) 845-0778

BMC Data

Low Shrink BMC Compound

Low shrink BMC compounds are general purpose formulations used for a variety of applications, usually requiring a colored part. This type of compound is most commonly used in small appliance housings, backboards, sanitary parts, and corrosion applications. The material shrinkage is between 0.005 - 0.000 in/in. Phoenix's CSX hybrid glass fibers have worked effectively in low shrink compounds and have replaced as high as 50% of the virgin chopped strand.

Typical BMC Formulation

Raw Material	pph	%
Aristech MR-13017	70	13.73
Aristech MR-63004	30	5.88
TBPB Catalyst	1.5	0.29
Byk 995	1.5	0.29
Zinc Stearate	4.0	0.78
Aristech Mod ME	1.0	0.20
Camel Wite	300	58.82
OCF 405 1/4" Glass Phoenix's CSX Fibers		20.0
	408 pph	100 %

Physical Properties

	Notched Izod (ft-lbs/in)	Tensile Str. (ksi)	Flexural Str. (psi)
Control	5.0 ± 16.1%	5.5 ± 17.1%	17190.8 ± 22.34%
Replacing 25% using a 1 : 1.1 ratio	4.9 ± 20.8%	5.3 ± 16.8%	15396.5 ± 17.5%
Replacing 40% using a 1 : 1.25 ratio	4.3 ± 21.3%	5.1 ± 18.6%	13892.6 ± 16.1%
Replacing 50% using a 1 : 1.25 ratio	3.9 ± 14.8%	5.0 ± 12.78%	12721.3 ± 14.8%

(Replacing virgin glass with Phoenix's silane sized, CSX hybrid glass fibers)

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APPENDIX 3

- Selected Media Reports

SMC, NATURALLY IT'S RECYCLABLE.

Season after season, a vehicle's exterior body panels made of sheet molding composite (SMC) endure nature's often harsh realities. When the time comes to recycle those corrosion- and dent-resistant SMC components, some will find new life as replacement parts in the service and repair industry, while others will be reprocessed and made into production parts for new models.

A number of molders have engineered recycled SMC for use in several North American vehicle applications. Future models will make even greater use of the recycled material in exterior, interior and underhood components. And further proving the viability of recycling, the composite molders in Europe and Japan are also using recycled SMC as filler in production parts.

To learn more about SMC's numerous benefits, the recycling processes or why it might be the right material for your specific application, contact the SMC Automotive Alliance at 313-358-9607.

Phoenix helps US moulders recycle composites

At a time when European car makers are concluding that thermoset composites are not feasibly recyclable, several of the US automotive companies are preparing to include recycled SMC in specific non-Class A production parts for the 1993 model year. The recycled SMC filler that will allow the specific FRP parts to bear the label 'recycled content' has been generated by Phoenix Fibreglass Inc of Canada. The company describes its operation.

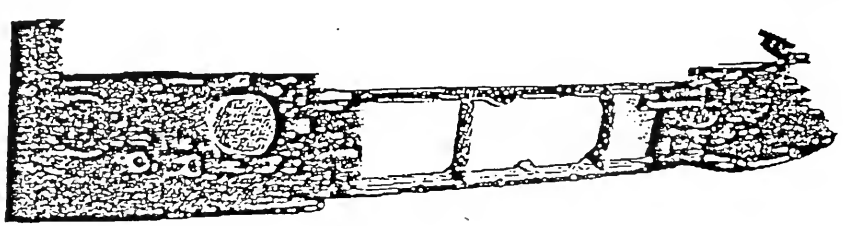
Toronto-based Phoenix has developed a unique technology to recycle post-industrial and post-consumer composites wastes. The technology, for which a patent is pending, cleanly separates the glass fibre from the waste, leaving a high quality fibrous material and a powder suitable for use as a filler. The process is completely mechanical, and involves no chemical or thermal decomposition. The process is also efficient, with over 99% of accepted waste being processed.

Although Phoenix's recycled material has yet to be seen by any moulders in Europe, industry representatives in North America and Southeast Asia acknowledge that it is the highest quality recycled fibre reinforced plastic (FRP) currently available in the global marketplace. The fibres and fillers are both suitably high in quality to be used as an additive to replace a certain volume of virgin material in many applications. The result, for FRP manufacturers, is that their products can be considered 100% recyclable, and can also be labelled 'recycled content.'

Currently, five members of the SMC Automotive Alliance (SMCAA) are participating in an initiative to replace 20% by volume of filler with recycled sheet moulding compound (SMC) filler in automotive production parts. Phoenix Fibreglass was enlisted to accept scrap SMC from participating Alliance members, process the material, and return the filler to the original manufacturers. The Alliance members are in the process of obtaining approval for their products from the major automotive companies. While there have been approvals made on the part of several of the automakers, official announcements have yet to be released (see Applications News).

The success of many recycling initiatives depends on the ability of the recycled material to be used, fully or in part, as a replacement for virgin material in the same production processes. For the composite industry, the challenge is to generate recycled materials which can be used in the same applications, instead of being re-used in ever less demanding applications. This must also be done in an economically viable way, for both the recycler and the end-user.

Phoenix Fibreglass believes that its 'fibre separation' technology, capable of generating consistent fibres and fillers for highbred additive applications, is the most economically-viable and environmentally logical of all current FRP recycling methods. Phoenix chose not to pursue chemical recycling methods (pyrolysis) as incineration is politically unpopular in Canada, and the process does not allow for the recovery of the fibres. Phoenix has also been sceptical of 'grinding' technologies because the value of



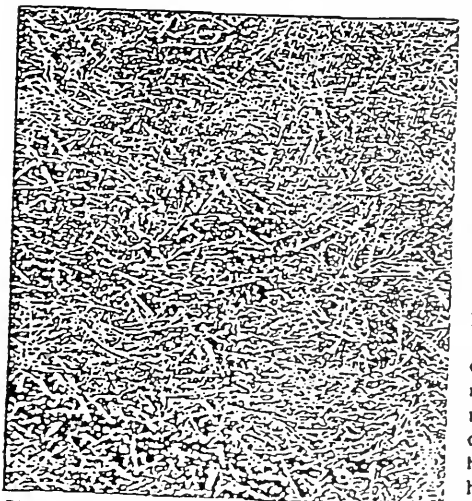
Bumper component 20% recycled content (fibres) from Phoenix Fibreglass.

the fibres is eliminated and it would be impossible for a recycler to compete with the low-price of virgin fillers such as calcium carbonate.

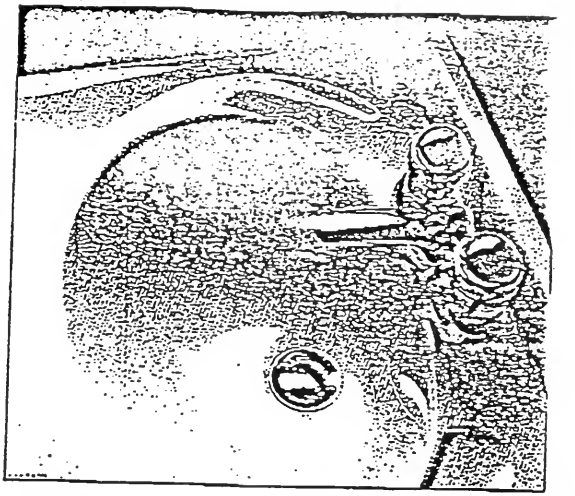
Phoenix Fibreglass Inc evolved when founder Bryan Sims, a yacht architect, focused his knowledge of fibreglass applications towards recycling processes as the recession hit the marine industry in the late 1980s. In 1990, Phoenix began working with Canada's National Research Council and the research group Ortech International on laboratory tests of mechanical separation processes. By the autumn of 1991, Phoenix was operating a pilot plant capable of processing up to one tonne of material an hour.

In the summer of 1991, Phoenix opened its first commercial recycling facility, and has already begun processing material. The Phoenix facility should reach full scale production early in 1993, and will be processing over 4000 tonnes of material a year.

The economics of recycling FRP waste using the Phoenix fibre separation method are promising. The firm acknowledges that the sale of recycled fillers alone would not be adequate to recoup the research and development investment and meet operating costs. The company attributes its economic viability to the 'value added' ability to generate recycled fibres. Phoenix currently markets its fibre products at between 10 and 20% less than the price of comparable virgin fibres. The potential revenues from both the fibres and fillers will allow Phoenix's commercial operations to succeed, especially since the main operating cost for the recycling facility is electrical energy.



Phoenix-recycled CSX-2i post-industrial waste, comparable to chop strand.

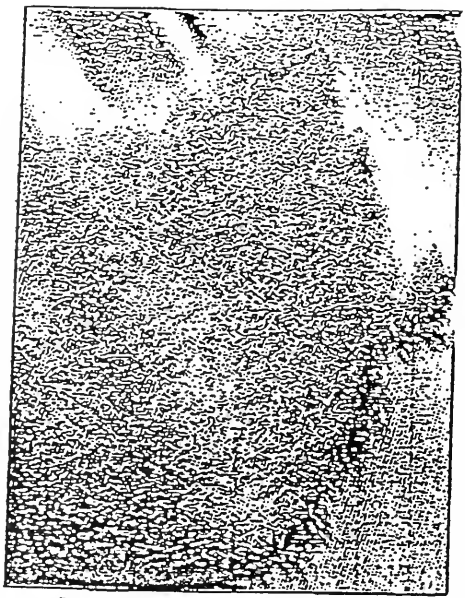


Sink made from BMC containing 20% recycled content (fibres) from Phoenix Fibreglass.

Currently, Phoenix markets two classifications of glass fibres — one for the automotive industry and one for other industrial uses. The same applies to the two categories of filler. Phoenix's CSX-2i consists of glass fibres which have an average length of approximately 25 mm generated from recycled polyester based post-industrial waste. These fibres are similar to virgin chopped strand fibres, yet have the added feature of impregnated polyester resin in each fibre. CSX-2s is also similar to chopped strand, and is made from recycled SMC, which means that the fibres are also impregnated with a mix of calcium carbonate and polyester resin.

Phoenix's premium quality filler/extender, PHX-20i, consists of fine polyester and glass particles having an average size of 20 µm, and is recycled from polyester based post-industrial fibreglass waste. The unique composition of PHX-20i enables the catalyzed polyester particles to bond, or 'link', with the virgin polyester resin molecules. This feature, together with the glass fibre content, sets PHX-20i apart from comparably priced virgin extenders. Phoenix also offers a filler made from recycled SMC, PHX-20s which consists of fibre polyester, calcium carbonate and glass particles with an average size of 20 µm.

Aside from the automotive industry applications under development by various SMCAA members, other tested applications for Phoenix's products range from electrical casing components to consumer goods such as bathroom sinks. Both the fibres and fillers have been used in bulk moulding compound (BMC) applications, and the fillers also have potential in thermoplastics manufacturing.



CSX-2i post-industrial waste, comparable to chop strand.

One of the key challenges for Phoenix is the development of a functional technology for dispersing the recycled glass fibre during sheet moulding applications. Phoenix is currently working with a Canadian moulder to deliver an effective method of incorporating recycled SMC fibres back in sheet moulding applications, thereby 'closing the recycling loop'. Phoenix anticipates that this technology could be available during 1993. Clearly, one major benefactor of this development would be the SMC Automotive Alliance which acknowledges that it is under pressure by the original equipment manufacturers (OEM) to supply parts which are both 'recyclable' and contain recycled content.

Phoenix accepts waste composites from a wide range of industries in both Ontario and Quebec, and the United States, particularly from the automotive, electrical and consumer goods sector. Generally the waste is free of contaminants, but all waste deliveries are pre-screened prior to processing. Waste containing filler, such as SMC and BMC, is processed together, and non-filled wastes, such as open mould cut-offs, are processed separately. Sourcing adequate amounts of waste to meet production orders has been helped by the fact that manufacturers in Ontario often face landfill 'tipping fees' of up to Canadian $100 per tonne, therefore sending waste to Phoenix's facility is a cost-effective alternative.

Throughout all trials, Phoenix has focused on processing post-industrial waste. Research indicates that there are significant post-consumer recycling opportunities, ranging from discarded consumer goods containing FRP to composite 'auto fluff' and construction waste that often ends up in landfills. Phoenix is currently exploring post-consumer waste recycling strategies with a key player in Canada's transportation and shipping industry.

Product consistency remains the key priority for Phoenix's customer. Phoenix has introduced strict quality control procedures and has installed an in-house laboratory in its Canadian recycling facility to test each batch of processed material to meet industry standards. Sophisticated monitoring equipment is used to measure the ratio of glass to resin in the recycled material, and a particle size analyser is employed to ensure that particle size and distribution of filler meets customer specifications. Phoenix also tests for moisture, bulk density and paste viscosity. To verify quality it includes a laboratory report on the specific lot sample with each product shipment.

To foster market development, Phoenix has been supplying test material samples and sharing application knowledge with interested manufacturers in a wide range of sectors. The automotive industry in North America has clearly shown the highest degree of interest in the recycled materials, but consumer goods manufacturers have also proven interested in the capability of offering 'recycled content' goods to the environmentally-aware public.

Phoenix's Canadian recycling facility was designed to serve Ontario and Quebec markets, as well as the US FRP industry. The company predicts it will eventually open a recycling facility in the USA as markets for the material grow. At the same time, Phoenix is currently working towards licensing agreements and strategic alliances that could soon result in overseas export of its recycling process.

As the debate regarding the future of composite recycling continues throughout the industry, Phoenix remains confident that its recycled products and technology provide solutions for manufactures under pressure to close the 'recycling loop' by offering products which are both fully recyclable and which contain recycled content. Further, these objectives can be achieved at low cost for the manufacturer, without any compromise in end product quality.

E

Product used in Corvette

Canadian breaks code to recycle glass fibre

Every carmaker is bragging these days that its plastic parts are coded, meaning their composition can be identified by present and future recyclers.

The problem remains: where is all this recycled stuff going to go? As BMW points out, turning plastic fenders into plastic flower pots isn't really recycling. Until you can make fenders into fenders, you're just delaying the inevitable trip to the landfill.

So it was a pleasant surprise that one of the press releases surrounding the 1993 Chevrolet Corvette said that some of its internal components would be made with glass fibre that contained up to 20 per cent recycled material from old Corvette fenders (or other similar sources of fibre). They like to say that Corvettes last forever — maybe, some day, they will.

The unpleasant side of the announcement was that, coming as it did from the United States, it contained absolutely no reference to where this recycling breakthrough was developed.

(Hey guys, it's called Canada. You know Windsor? That city just south of Detroit? That's Canada. Remember Toronto? Home of the World Series Champion Blue Jays? We play in the same division as the Tigers? That's Canada.)

The Oakville-based company that deserves the credit is cleverly named Phoenix Fibreglass Inc. after the mythical Egyptian bird that resurrects itself from its own ashes. It was formed in 1991 by yacht architect Bryan Sims after the marine industry was crushed by the on-going recession.

(It's a perfect example of Brian Mulroney's strategy for Canada's high-tech future: destroy an entire industry, and maybe one guy will be smart enough to figure out a way to survive. My, we're in a politically nasty mood today, aren't we?)

Sims focused his knowledge of glass fibre applications toward the obvious and growing need for recycling this virtually indestructible material.

Working with a grant from the National Research Council, Sims and the research group Ortech International of Mississauga conchanical process for separating the glass fibre strands from the "fillers" and bonding resins, rather than using heat or chemical processes, both of which pose environmental problems of their own.

The only procedure previously available for recycling glass fibre was to grind the whole part into a pulp, which could then be used to replace virgin filler in the glass fibre mix.

But as Phoenix vice-president for marketing, Randy Bastarache, puts it, "You're then competing with calcium carbonate — essentially, clean dirt — which you can buy for a nickel a pound. It's hard to make any money that way."

Still, the Phoenix-supplied material in the 1993 Corvette (which goes into the rear window support panel, which you don't see on the car's exterior) is, indeed, filler.

"The carmakers are under a great deal of pressure to increase the amount of recycled product in their cars, and to ensure the end-product is also recyclable.

"Our recycled filler doesn't really win on an economic basis right now, although it helps meet the carmaker's recycling goals. It's also a bit lighter, which in itself has some environmental benefits in reduced car weight, hence improved fuel economy.

"The next step is to produce a so-called 'class A' part, one with exterior-quality surface finish, using recycled filler. GenCorp, the Indiana-based moulded-parts manufacturer who's supplying the Corvette piece, has already shown the capability to do this.

"But the carmakers want the moulding companies to walk before they run, so it may be a while before this part is approved for production.

"Where the payoff is down the line is that our process also lets us recycle the glass fibre strands that give the material its strength.

"Our first step in this regard will be to make 'bulk moulded compound' pieces, like headlamp surrounds, using recycled strands as well as filler. The eventual goal for us and the moulders is make class A parts using up to 20 per cent recycled strands and filler.

"We can then achieve a cost reduction of from 10 to 15 per cent, as well as helping meet the environmental objective of truly making new fenders from old ones."

Phoenix's corporate progress was very rapid. A pilot program was in operation by the end of 1991, and a commercial operation began early this year. By the time it's fully operational in 1993, it should be producing over 4000 tonnes of material a year.

Phoenix gets its raw material from various industrial operations in Canada and the United States. Most of it is "post-industrial waste", meaning by-products of glass fibre manufacturing or fabricating outfits — end cuts, scrappage, and so forth.

There's an immediate benefit to the creator of the scrap material. Instead of paying some municipality up to $100 in 'tipping fees — the charge to use the landfill — the originator of the scrap sends it at no charge to Phoenix.

Some of Phoenix's raw material is "post-consumer" waste, meaning discarded products, the Holy Grail of recycling. This component must go through additional labor-intensive processes to ensure it is clean — no metals no contamination — and to en sure that the correct coded part are all placed in the same "box' because different plastics requir different treatment.

Recycled glass fibre can also b used in a variety of other proc ucts, such as bathroom sinks. Bu the auto industry has been th big supporter of the effort, sinc it is using lightweight and rust free glass fibre materials in ever increasing amounts.

"The co-operation from th panel makers and the carmaker has been outstanding," says Bas tarache. "We got approval for th Corvette part in record time, an while it will take a bit longer fc the exterior panels, we're conf dent we'll succeed."

At the moment, Phoenix onl has one competitor worldwide, German outfit. But Bastarach says a third-party analysis has ir dicated that Phoenix's product i superior.

"We plan to sell not only toj quality recycled glass fibre mat rials, but also to license the tecl nology to other countries," say Bastarache.

And make a bunch of mon doing so. I thought a Canadia high-tech success story mig brighten up your Saturday mor ing.

Carte Blanche

Jim Kenzie

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update

G. Harte

September 24, 1992

America's number one sports car is first to go "green"

s if two major milestones are not nough for the Chevrolet Corvette — building of the one-millionth and a anniversary edition — America's ber one sports car adds a third lestone to its summer roster: it's the to go "green."

tarting with 1993 model year roduction, the Corvette becomes the t vehicle in the North American mobile industry to use recycled t-molded-compound (SMC) body anels. Chevrolet General Manager C. Perkins announced this mile- e at Chevrolet's Sept. 23, 1992, urt Lead" media briefing in Roches- r, Mich.

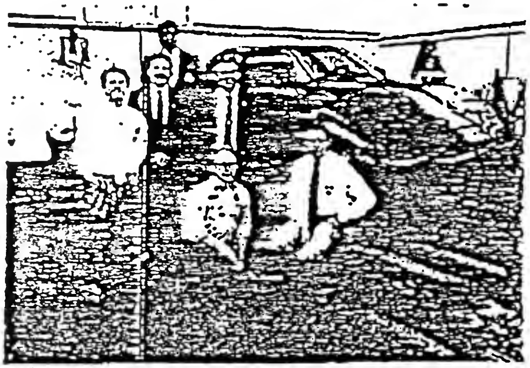
Corvette lovers know full well that vettes last forever," Perkins said. ut our Corvette engineers have gone extra step to use this recycled SMC rial in lightweight, low density r panels. Our goal is to keep every rvette on the road forever as well as uce environmentally correct parts e Corvette."

The recycled material consists of the resins and strength characteristics gin material. The material is ground to a particle size that is compatible with the processing equipment normally used in the production molding process.

Use of recycled SMC in low density inner panels on the 1993 Corvette is the first recycling program outlined and completed by Gencorp Automotive.

"GM's testbed for this new technology resulted in an outstanding team effort on the part of Chevrolet Motor Division, the Corvette platform, GM's Advanced Engineering, GM's Materials Engineering, the Bowling Green Assembly plant and Gencorp Automotive," Perkins said.

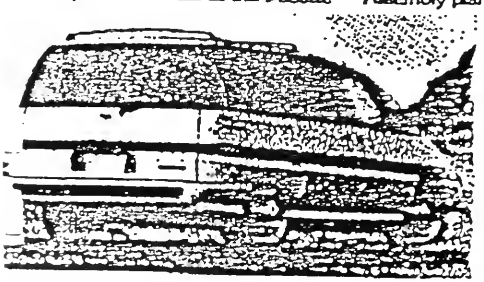
"Corvette has always been recognized as the innovative leader in technology, performance, styling and excitement," he added. "The use of recyclable body panels in the 1993 Corvette is significant, since previously this material would have gone to landfills."



The team that validated the SMC body panels and the 100,000-mile validation vehicle (clockwise from left): Don Viecko (test lab), Al Wagner (release engineer), Sam Sims (design check), Dick Holms (materials engineering), Geoffrey Gould (validation) and John Soontag (test lab). Team members not pictured are release engineers Ameil Kapadia, Steve Dobrot and Terry Lynn.

lds Silhouette one of product highlights at media briefing

e Oldsmobile Division unveiled its lineup to the media at the Midsize Automotive Division's Oklahoma City Assembly plant Sept. 15-16. The Silhouette was one of the product highlights.



993 Oldsmobile Silhouette

The Silhouette has an improved interior acoustics package for 1993 and new front and rear fascias, lights and an optional sunroof.

An innovative change for the Silhouette is a power-operated sliding side door. The door can be operated from a button on the overhead console up front, at the B-pillar for middle row passengers, or with the remote keyless entry system. The door will only operate when the transmission is in "park," and the driver can lock out the B-pillar control to prevent children from playing with the door. If there is an obstruction in the door's path, it will automatically stop and reverse its direction of travel.

The feature is a GM exclusive and will be offered to customers as optional equipment midway through the model year.

SPE honors carmakers for plastic parts

y Roger Rowand
ASTICS NEWS CORRESPONDENT

DETROIT — The front fenders of rysler Corp.'s newest entries in e rough-and-tumble auto sales rby won the Grand Award at the nd annual awards night of the ciety of Plastics Engineers, Nov. , in Detroit.

The fenders of the Dodge In- id Chrysler Concorde and Ea- e Vision midsized sedans led the mpetition for best overall Inno- tion in use of plastics in the au- industry this year. The family of hicles, known as the LH cars, e assembled at Brampton, On- rio, and went on sale in August. rysler's investment in the line taled about $1.6 billion and led airman Lee A. Iacocca to say e company had "bet the farm" its sales success.

The injection molded fenders ere developed by Chrysler in rtnership with DuPont Automo- ve Products of Troy, Mich., and olded of DuPont's Bexloy K 550 Plydex Inc., a division of Magna ternational In Aurora, Ontario. gna's Rimply Inc. in Newmar- t, Ontario, primes the fenders d ships them to Brampton for inting and assembly.

Chrysler Corp.'s LH cars also on in the body interior category, e of the competition's nine oupings. The cars' innovative in- rument panel incorporates a ssenger-side air bag, air condi- oning and glove box with hrysler's first plastic living hinge. he panels are molded by David- on Instrument Panel/Textron of

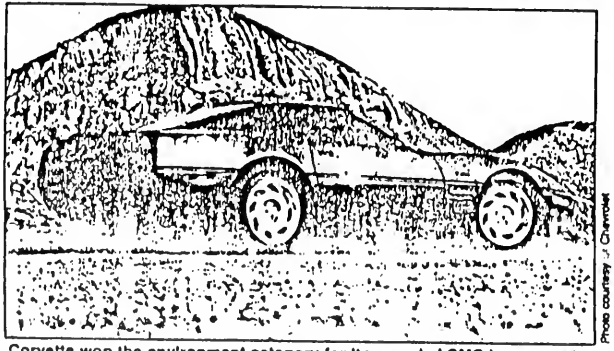


Photo courtesy of Chevrolet

Corvette won the environment category for its recycled SMC inner panels.

Dover, N.H.; Lescoa Inc. of Grand Rapids, Mich.; Bluewater Plastics Inc. of Marysville, Mich.; and Chrysler's Acustar Inc. of Troy, Mich. Material suppliers are General Electric Co., Exxon Chemical Co. and RheTech Inc. of Whitmore Lake, Mich. The materials used are Taffen, Azdel, Noryl and polypropylene.

The driver-side air bag is in the center of the steering wheel.

In the competition's powertrain category, honors for innovation went to the injection molded, two-piece thermoplastic air intake manifolds on General Motors' 3800 V-6 engine. That engine is standard on several car lines, including Buick LeSabre and Park Avenue, Oldsmobile 88 and 98 and Pontiac Bonneville, and optional on Buick Regal and the plastic-bodied GM minivans, Olds Silhouette, Pontiac Trans Sport and Chevrolet Lumina APV.

Judges said the winner is the first high-volume thermoplastic manifold to be made in North America. They said it weighs seven pounds less than the aluminum manifold it replaces. Judges said the GM product is the first composite manifold in the world to use a clock-and-lock attachment feature for the exhaust gas recirculation tube, vacuum-tree fitting and the positive crankcase ventilation valve, resulting in major assembly cost savings.

GM's AC Rochester Division of Flint, Mich., is the processor. The material used is DuPont Zytel.

In the SPE competition's category for process innovation, the Flexible Bright radiator grille of Ford Motor Co.'s Lincoln Mark VIII was the winner. The urethane grille is coated with a bright metal finish that is vacuum deposited in microscopic island form rather than as a conventional continuous film that can crack during flexing.

The processor for the part is Windsor Plastics Inc. of Evansville, Ind. Flexible Bright is a product of Davidson Bright Trim/Textron of Dover, N.H., a division of Textron Inc. of Providence, R.I.

In the materials category, honors for innovation went to wheel covers for Pontiac Grand Am and Sunbird and taillight moldings for Lincoln Continental. Those plated ABS-polycarbonate blend components reduce weight, withstand heat and are resilient, judges said. The molder is Lacks Industries of Grand Rapids, Mich. Dow Chemical Co. of Midland, Mich., supplies the material. Lacks Industries calls it HIPP-140, High Impact Plated Plastic.

GM's Delco Chassis Division of Dayton, Ohio, won in the chassis/hardware category for its mini-motor washer pump. The device features snap-fit design requiring no secondary operation and an impeller design that improves efficiency by 30 percent. Also cited were the pump's lower cost and application flexibility, which means it can be used in all GM car platforms with only minor changes. The material used is Celcon acetyl copolymer from Hoechst Celanese of Auburn Hills, Mich.

Winning in the SPE's hall of fame category were the exterior body panels of the Chevrolet Corvette introduced in 1953. The Corvette had the first plastic automotive body panels, exterior and structure, judges said. Robert Morrison, founder of Molded Fiberglass Co., in Ashtabula, Ohio, was recognized for his contributions to the Corvette and the industry.

Winner in the competition's international grouping was the complete front-end module assembly for the Volkswagen Golf A3 from Volkswagen AG of Wolfsburg, Germany.

The thermoplastic item is a one-piece integration of radiator support structure, radiator, cooling fan, fan shroud, head lamp carrier and head lamps. The application cuts weight and trims cost by reducing material-handling requirements and assembly time.

The maker of the glass-mat-reinforced modular part is Peiner Kunststofftechnik of Germany using BASF Elastogran.

Corvette also was selected as a winner in the environment category because of the innovative use of recycled sheet molding compound in the car's inner panels. The application, first of its kind in the United States, eliminates waste material going to landfill by using SMC scrap for new parts.

GenCorp Automotive of Akron, Ohio, performs the recycling using a process developed by the 32-member SMC Automotive Alliance, a unit of the Society of the Plastics Industry Inc. of Washington.

Among the nominees in this year's competition was the Ford Motor Co. Econoline modular headliner (passenger compartment ceiling) panel with molded-in air conditioning duct and outlets. The large piece is molded of glass-reinforced polyurethane at Ford's Mount Clemens, Mich., plastics plant.

Courtesy consolidates, adds nine presses

ly Bruce Vernyl
LASTICS NEWS STAFF

according to Gerald J. Sommers, vice president of Courtesy Corp.

cessing heat-sensitive materials, Sommers said.

approval from the Food and Drug Administration, and is a unique

jection capacities of 3-65 ounces, he said.

Yacht designer sails into uncharted waters

OAKVILLE — When one business idea doesn't work out, you can either sulk, or jump into something else.

Yacht designer Bryan Sims faced that choice last year, and now he's on the verge of revolutionizing the fibreglass business by developing an economically viable way of recycling the material.

The process has cost $500,000 and has taken a year to develop, but interest in it is growing quickly.

Mr. Sims, president of Phoenix Fibreglass, has perfected what that industry has lacked for years, a profitable way of recycling its wastes either after production or consumption.

"A lot of other companies have looked at different ways of doing this, but we're the first to come up with something that is commercially viable," he said in a recent interview.

According to estimates produced for the company, Ontario manufacturers use 34,000 tonnes of fibreglass/polyester resin each year, with between 5 and 7 per cent ending up as waste destined for landfill sites.

A combination of fabric, resins and catalysts, fibreglass is a popular ingredient for products that require strength and flexibility in their final uses.

Auto parts, boat hulls, shower stalls and even Ski-Doo bodies are examples.

"Fibreglass is fairly expensive, so it's usually only used where there has to be some performance characteristics," he said.

What Phoenix is ready to offer the market is a mechanical way of recycling waste fibreglass that separates the fibres according to length.

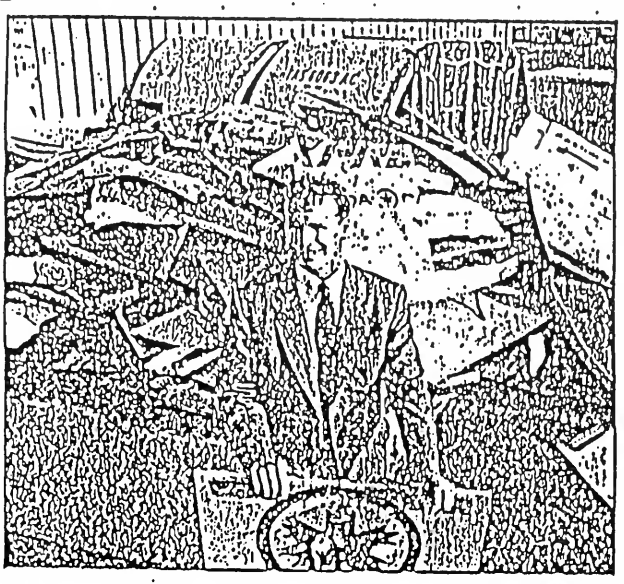
Those recycled fibres, he added, can be up to 25 per cent less expensive than virgin material, and they don't affect the quality of the final product.

That's a complete departure from past methods, he said, which have sought ways to reduce the product containing the fibres, usually by heat.

The heating methods reduce the entire product to waste oil and fibreglass. Aside from handling the by-products, such methods have proven highly expensive.

By using a mechanical system, Phoenix is able to separate the fibres by length, ending up with a product that's much easier to market.

Trained as a yacht designer, Mr. Sims set up his own business several years ago, but found the market difficult to crack.



John Hamilton, The Spectator

Phoenix president Brian Sims with the raw materials of his new venture.

"There just wasn't a lot of work around," he said. "I looked at the market and asked if it would get any better, and when I decided it wouldn't, rather than dragging my chin on the ground I started looking for something to do."

In yacht design he had been accustomed to working with fibreglass and knew of the problems with recycling it.

That's how he settled on his target.

"I knew that if we could get the fibres out of the products then we'd be able to sell them," he said. "The trick was to get them out.

"The real difference about our method is that we can get the fibres out and they're still usable."

Then, with money raised from the National Research Council and a group of private investors, he commissioned researchers at Ortech International, in Mississauga, to find a solution.

Since the patents on that solution are still pending, he won't say much about his system, other than that it's a mechanical process that doesn't require burning.

"We knew that because of the political climate right now a mechanical process would be the only thing that was viable," he said.

Marketing, he said, has been at the heart of the effort. Whatever the final method was, it had to be something that made sense for the market.

"We are always looking at the economics, we wanted to get at the part of the business that was value-added, we wanted to get the fibres out of there," he said. "We don't come from the environmental background.

"Whatever we do has to make economic sense first of all."

From a start in 1990, Phoenix is now operating from a pilot plant located on the Ortech grounds, but the search is already on for a permanent home.

The price tag for that plant will be between $2 million and $3 million for "an ideal operation" and as little as $1 million for a bare-bones operation.

"We've gone from lab scale to the pilot plant fairly quickly, and now there is a lot of technology transfer happening with our people," Mr. Sims said.

"We're really trying to confirm the markets for it, because that's what we're going to need to get the investment for the full scale-facility."

His contract with Ortech requires him to be out of the pilot plant by mid-May, so the search has a certain urgency to it, he admitted.

"It's a bit of a logistical nightmare right now, it's a bit of juggling act," he said.

When he "goes commercial" with the system, Mr. Sims sees customers at two ends of the process — buying waste fibreglass from one set and either selling the recycled fibres back to that customer or to another user.

"Timing is everything in this business," he said. "As soon as you say it's recyclable and it might make some money at the end of the day, you get interest in it."

"What we have to do it take it out of saving the world and make it commercially viable," he added. "This thing is growing so rapidly it has taken us all by surprise."

Phoenix currently employs five people in its Oakville office. When the recycling plant is established and at full production, it could employ another 30.

The company is looking for sites between Niagara and Mississauga.

"The next six months will really decide just how big this thing gets," he added. "It all depends on the markets. It all comes back to the markets."

"We're always going to be bound by the waste stream, so I don't think we'll ever get any bigger than 5 to 7 per cent of the market."

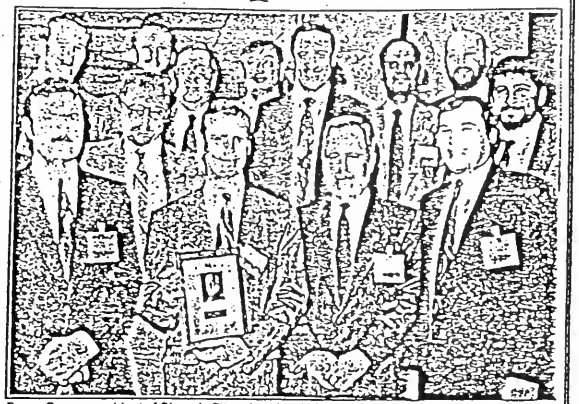
Local recycler is top innovator

Phoenix Fibreglass Inc.

Phoenix Fibreglass Inc. of Oakville has been presented with the Sir Joseph Flavelle Award for Technical Innovation. The award was presented on Wednesday by Mississauga-based ORTECH International, a large technical services organization. The ceremonies take place at the Sheridan Park Research Community.

A relatively new company, Phoenix Fibreglass Inc., with financial assistance from the National Research Council's Industrial Research Assistance Program, has developed North America's first commercially-available fibreglass recycling technology. This unique mechanical process separates fibreglass into its two main components – fibres and resin – that become new raw material for such products as boat hulls, roofing shingles and automotive components.

In presenting the Awards, ORTECH president Dr. Ross Lawford explained why they were named after the Canadian business magnate and first chairman of ORTECH. "Sir Joseph Flavelle saw industrial success as the route to prosperity in Ontario and in Canada," Lawford emphasized. "He understood that first prize goes to those companies on the leading edge ... the innovators.



Bryan Syms, president of Phoenix Fibreglass Inc. holds the prestigious Sir Joseph Flavelle Award for Technical Innovation. The award was presented by ORTECH International this week. Looking on (front row l to r) is Bill Hewitt, vice-pres. operations for Phoenix, Bryan Syms, Dr. Ross Lawford, pres. ORTECH Intnl; and Randy Besterache, vice-pres. marketing, for Phoenix. They are surrounded by fellow officers of Phoenix and the ORTECH technical team.

(Photo by ORTECH)

Fiberglass joins growing list of recyclables

TORONTO (Reuters)—Old bathtubs, boat hulls and roof shingles can be recycled instead of being dumped in landfills.

Phoenix Fibreglass Inc. of Oakville, Ontario, has developed a mechanical process for recycling fiberglass without incineration or producing polluting byproducts, President Bryan Sims said.

Several companies are developing technology to recycle fiberglass, widely used to strengthen everything from bathroom sinks to car bodies, but Phoenix is the first to offer it commercially, he said.

The recycled product is up to one-third cheaper than new fiberglass, Sims said. "It's really nice to have recycled products, but tough to sell to industry if you can't give them a good deal."

Unlike other methods under development that burn the fiberglass and produce an oily residue, Phoenix mechanically separates the material into its two main components—fibers and resin, which can then be sold.

"We can use 99 percent of the original product," Sims said.

Canada produces about 52,000 metric tons of fiberglass annually.

Phoenix operates a pilot recycling plant and plans to build a $2.7 million full-scale facility capable of recycling 160 tons of fiberglass a month.

Enviro-Fibre Ltd. of La Guadeloupe, Quebec, is the first company to buy Phoenix's recycled fiberglass and plans to use it in the large blue containers made for collecting recyclable bottles and cans in public places.

THE JOURNAL OF COMMERCE, Thursday, November 14, 1991

Canadians Develop New Process To Recycle Fiberglass Products

TORONTO — Old bathtubs, boat hulls and roof shingles now can be recycled instead of being dumped in landfills.

Phoenix Fibreglass Inc. of Oakville, Ontario, has developed a mechanical process of recycling fiberglass without incineration or producing any polluting byproducts, Bryan Sims, company president, said.

Several companies are developing technology to recycle fiberglass, widely used to strengthen everything from bathroom sinks to car bodies, but Phoenix is the first to offer it commercially, Mr. Sims said.

The recycled product is up to one-third cheaper than new fiberglass, he added.

"It's really nice to have recycled products, but tough to sell to industry if you can't give them a good deal," he said.

Unlike other methods under development that burn the fiberglass and produce an oily residue, Phoenix mechanically separates the material into its two main components — fibers and resin, which then can be sold.

"We can use 99% of the original product," Mr. Sims said.

Canada produces about $2,000 metric tons of fiberglass annually, and much of it eventually ends up in landfills, Mr. Sims said.

Phoenix now operates a pilot recycling plant and plans to build a $C3 million (US$2.7 million), full-scale facility capable of recycling 160 tons of fiberglass a month, he said.

Enviro-Fibre Ltd. of La Guadeloupe, Quebec, is the first company to buy Phoenix's recycled fiberglass and plans to incorporate it into the large blue containers used for collecting recyclable bottles and cans in public places. (Reuter)

THE TORONTO STAR Monday, November 4, 1991

Oakville firm plans to recycle fibreglass

An Oakville firm says it has developed North America's first commercial fibreglass recycling technology.

The mechanical process separates fibreglass into its two main components — fibres and plastic resin — that become new raw material for boat hulls, roofing shingles and car bumpers, says Bryan Sims, president of Phoenix Fibreglass Inc.

The company was incorporated last June by Sims, who has operated a yacht design firm for several years.

It now operates a pilot recycling plant in Mississauga and plans to build a $3 million, full-scale facility, capable of recycling 160 tonnes of fibreglass a month, somewhere in southern Ontario, Sims said.

Eagle-Picher, with ecology in mind, recycles substance for auto parts

By KERRY BOYER

While other industries use recycled materials in everything from paper towels to glass bottles some plastics manufacturers, including a division of locally based Eagle-Picher Industries Inc., have discovered a way to recycle automobile parts.

Years of research into methods of recycling sheet-molding composite (SMC), a glass-reinforced plastic, has finally allowed manufacturers to use recycled materials in molded car parts ranging from engine covers to body panels.

Eagle-Picher Automotive Group's plastics division, in Grabill, Ind., used 7% recycled sheet-molding composite in an engine cover it just produced for Ford Motor Co.'s Econoline van. The part, which fits around the base of the engine inside the van, awaits approval from Ford after the auto maker completes testing on the part, said Roger Schwartz, vice president of automotive sales at Eagle-Picher's plastics division and chairman of the SMC Automotive Alliance (SMCAA). The company is also awaiting approval from Chrysler Corp. on a molded interior trim part it made with recycled sheet-molding composite.

Concerned about overflowing landfills and skyrocketing waste disposal costs, Eagle-Picher and other plastics molders several years ago began exploring ways to use recycled sheet-molding composite. To effectively pool researching efforts, the companies in 1988 joined a newly formed trade group, the SMCAA, a Michigan-based trade organization made up of companies that provide the automotive industry with sheet-molding composite products.

The research was also prompted, in part, by pressure from the automotive industry to use more recycled materials in molded car parts, said Don Norris, vice president of engineering at Eagle-Picher's plastics division. Plastics molders and auto makers worked together on the research, which eventually resulted in a process for using reground sheet-molding composite.

The first step of the process involves shredding scrap sheet-molding composite parts into two-inch squares. The plastics molders send the squares to Phoenix Fibreglass Inc., a Canadian company and SMCAA member. Phoenix removes the glass fibers from the sheet-molding composite and mills the remainder into a fine powder, said Erin Millerschin, staff manager of the SMCAA. The molders combine the powder with other raw materials when molding the part.

Roger Schwartz

Eagle-Picher's research of recycled sheet-molding composite products involved extensive testing, including aging, ultraviolet exposure and salt-spray tests. "We had to confirm that there is no detrimental effect from using the recycled materials," Norris said.

"Our goal is to supply a material that has no different physical properties than the original — and we've done that," Schwartz said.

Before beginning to use recycled sheet-molding composite, Eagle-Picher installed a $150,000 shredder at its Grabill facility last year, Norris said. Officials say the investment will pay off in the long run.

In the future, the company expects to use the process more in manufacturing interior and exterior car parts, Norris said. He expects the use of recycled sheet-molding composite to save the company money it would spend on raw material and also to cut waste-disposal costs.

General Motors Corp. recently announced the first use of recycled sheet-molding composite in an auto body panel. GenCorp Automotive, in Akron, molded an inner panel for the back window of the 1993 Corvette using 20% recycled sheet-molding composite, Millerschin said.

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The information affecting your business

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GM and Ford are road-testing cars with recycled-content SMC parts,

sources in Detroit say. Performance is identical to all-virgin SMC (fiber-reinforced plastic sheet molding compound).

We're told that by the end of this year carmakers are likely to approve the use of SMC production parts containing 20% regrind. The recycled input material is scrap from compression-molding plants, not post-consumer sources.

Some molders, including GenCorp Automotive, have compression molded recycled-content SMC body parts with a Class A finish. However, at this point, road tests involve only non-appearance parts, including a structural Corvette part, which we believe is the radiatorsupport.

Knowing how particular most automotive engineers are about achieving a Class A finish, we suspect it will be a long time before recycled content will be approved in body panels. However, there are plenty of non-appearance and non-automotive SMC parts around to fill with in-plant regrind.

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NEW SALES OPPORTUNITIES...

Cored, reinforced-plastic safety capsules save lives of hydroplane drag boat racers. Boats in this dangerous sport go from zero to 200 mph in about 6 seconds over a 1/4-mile course.

The boats are powered by 4000-hp engines. Hulls are hand laid of fiber glass-reinforced resins with gel-coat finishes. The safety capsules are attached to the stringers with stainless steel bolts designed to break free in the event of a crash. The capsule's shells are usually hand-laid of aramid and glass